

Amendments to the Drawings:

The attached sheet of drawings include changes to Figure 16:

Sheet 1, which includes Figure 16, replaces the sheet that includes Figure 16.

Attachment: 1 replacement sheet.

REMARKS

Claims 1-59 are currently pending in the application. Claims 15 and 44-59 are canceled. Claims 1, 2, 4, 8, 11-14, 16-18, 20-26, 29-31, 33, 36, 39 and 41 are amended. Claims 60 and 61 are new. The amendments find support in the specification and are discussed in the relevant sections below. No new matter is added.

I. Restriction Requirement

Applicants affirm the election of claims 1-43. Applicants have canceled claims 44-59 without prejudice and should not be construed as a surrender of any subject matter. The right to file divisional applications on non-elected claims 44-59 is reserved.

II. Drawings

The Office Action states that “the drawings are objected to because Fig. 16 contains a nucleic acid sequence which is not identified by a SEQ ID NO: as required 37 C.F.R. §§ 1.821(d).”

Response

Applicants submit a proposed amended drawing herewith on a separate paper, showing the proposed changes in red, for the Examiner's approval. Applicants submit that the proposed amendments of Figure 16 are made only to comply with the Sequence Listing requirements, and that these amendments do not introduce any new matter.

III. Claim Amendments

Claim 1 is amended to incorporate the limitations of claims 14 and 15, and to clarify individual claim elements. Claims 2, 4, 16, 18 and 26 are amended to clarify individual claim elements. Claims 12, 13, 17, 18, and 36 are amended to clarify claim dependency. Claim 14 is amended to provide further limitation to claim 1 because the limitations of original claim 14 are incorporated into claim 1. Claim 15 is canceled because the limitations of original claim 15 are incorporated into claim 1. Claims 8, 9, 16-18, 19-23, 25, 29-31, 33 and 39 are amended to provide proper antecedent basis. Claim 24 is amended to be consistent with amended claim 1.

The remaining claim amendments are discussed in the relevant sections below. No new matter is added.

IV. Claim Objections

The Office Action states that claims 1 and 12 are objected to because of the following informalities: the syntax “a proximal and distal ends” in claim 1, and the syntax “a electrically,” in claim 12, is incorrect.

Response

Applicants have amended claims 1 and 12 to correct the informalities as suggested in the Office Action.

V. Claim Rejections Under 35 U.S.C. § 112 Second Paragraph

Claims 1-43 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1-23

The Office Action states that claim 1 is indefinite “because it is unclear whether the proximal ends are attached to the substrate or whether the recitation is a method step for attaching the proximal ends at some time in the future.” The Office Action suggests that the claim be amended to delete “being”. The Office Action also states that claim 1 is indefinite because the recitation “further comprising a metallic material” is “unclear whether the recitation modifies the substrate, the tubule or the device.” The Office Action suggests that the claim be amended to insert “said tubule” before “further”.

Response

Applicants have amended claim 1 to delete “being” as suggested in the Office Action. Applicants have also amended claim 1 to delete the term “further” and to recite that the metallic

material is attached to at least a portion of the carbon nanotube tubule including the distal end, clarifying that it is the distal end which comprises a metallic material. No new matter is added.

Claim 11

The Office Action states that “claim 11 is indefinite for the recitation ‘said substrate is a metallic or non-metallic material’ because the recitation seems to define the substrate as being any material and therefore it is unclear what limitations are being imposed by the recitation.”

Response

Applicants have amended claim 11 by deleting the limitation “metallic”. Support for the amendment is found throughout the specification, for example in original claim 11 and at page 3, line 5. No new matter is added.

Claims 14

The Office Action states that claim 14 is indefinite “because the recitations ‘biologically occurring compound’, ‘immobilized on the surface’, ‘the surface of the metallic material’ and ‘individual nanotubes’ all lacks proper antecedent basis in Claim 1.” The Office Action also states that “claim 14 is further indefinite for the recitation ‘wherein comprising the carbon nanotube array’ because the syntax is confusing and therefore, it is unclear how the recitation further limits the biological compound.”

Response

Applicants have incorporated the limitations of original claim 14 into amended claim 1. Applicants have amended claim 14 to replace the term “biologically occurring compound” with the term “electrically conductive biological compound”. Applicants have deleted the phrase and “individual nanotubes comprising the said carbon nanotube array”. Applicants have also amended claim 14 to recite that the electrically conductive biological compound is chemically bonded to the surface of the metallic material. Support for the amendment is found throughout the specification, for example at page 17, lines 9 through 19, and in original claim 17. No new matter is added.

Claim 16

The Office Action states that “claim 16 is indefinite for the recitation ‘at least two nanotubes in the said array by the surface immobilized biological compound’ because both ‘nanotubes’ and ‘surface immobilized biological compound’ lack proper antecedent basis in Claim 1.” The Office Action also states that the term “the said” is redundant.

Response

Applicants have amended claim 16 to replace the term “nanotubes” with the term “nanotube tubules” and to replace the term “surface immobilized” with the term “electrically conductive” to provide proper antecedent basis. Applicants have also amended claim 16 to delete the term “said” to remove the redundancy. Support for the amendment is found throughout the specification, for example in original claim 1. No new matter is added.

Claims 24-43

The Office Action states that “claims 24-43 are indefinite in Claim 24 because the claim contains two periods.”

Response

Applicants have amended claim 24 to delete the elements following the first period and have incorporated those elements into new claims 60 and 61.

In view of the above amendments to the claims, Applicants respectfully request that the rejections under 35 U.S.C. § 112 Second Paragraph be reconsidered and withdrawn.

VI. Claim Rejections Under 35 U.S.C. § 102(b)

Claims 1-5, 7-8, 11-12, 14-22, 24-27, 29-30, 33-39 and 41-43 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Colbert et al. (WO 98/05920).

The Office Action states that “Colbert et al. disclose a carbon nanotube array device comprising at least one nanotube with a proximal end and a distal end, said proximal end

attached to a substrate and said tubule further comprising a metallic material (page 38, line 25-page 39, line 23 and Fig. 8)" and that "the recitation 'capable of providing a surface for binding biological compounds coated or adsorbed thereof' does not describe or define structural components of the device but instead describes an intended use of the device." The Office Action also states that "a claim containing a 'recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus' if the prior art apparatus teaches all the structural limitations of the claim. The Office Action further states that "it is noted that Colbert et al. teach their device is capable of providing a surface as recited (see page 21, line 20-page 22, line 6 and Claims 46-48)." Applicants respectfully traverse the rejection.

Response

Colbert et al. disclose self-assembled monolayers (SAMs) created on a substrate (page 38, line 25 through page 39, line 5) by linking single walled nanotube (SWNT) molecules covalently to the substrate through a linker moiety such as an organic sulfide (page 39, lines 6 through 11). Simply stated, the nanotube molecules in Colbert et al. are not directly attached to the substrate, but rather they are linked to the substrate by organic linker molecules. Applicants' claimed invention, on the other hand, involves a carbon nanotube array wherein individual carbon nanotube tubules are grown directly on the surface of a substrate material by catalytic initiation of carbon nanotube tubule growth, and does not contain organic linker moieties as required by Colbert et al.. Applicants' invention neither requires individual carbon nanotube tubules to be aligned in a self-assembled monolayer prior to attachment to the substances as a SAM, nor requires a self-assembled monolayer to be covalently linked to the substrate through a linker moiety, as disclosed by Colbert et al.. Also, Colbert et al. requires pre-formed nanotubes that are coupled to organic linker molecules capable of spontaneous self assembly on a metallic substrate, followed by attachment to that substrate. The preformed nanotubes in Colbert et al. cannot attach to the substrate in the absence of the organic linker, and more importantly, cannot attach via formation of SAMs on non-metallic surfaces. Applicants' invention on the other hand, involves growth of carbon nanotube tubules on the substrate surface resulting in direct attachment and not indirect attachment to the substrate surface as disclosed in Colbert et al..

Further, such direct attachment of carbon nanotube tubules in Applicants' invention can occur on non-metallic surfaces, which is precluded in Colbert et al..

Furthermore, Colbert et al. disclose a carbon nanotube array that is either homogeneous or a random or ordered heterogeneous structure that is produced by aggregating SWNTs to form a monolayer (page 38, lines 26 through 30). Applicants' invention on the other hand, involves individual carbon nanotube tubules grown directly on the substrate at predetermined catalytic nucleation sites to result in precise placement of carbon nanotubes onto the substrate (page 4, lines 5 through 21 of the specification). Colbert et al. therefore, neither teaches nor suggests the attachment of carbon nanotube tubules directly to the surface of a substrate, particularly non-metallic substrates as disclosed in Applicants' invention.

Applicants have amended claims 1 and 24 to clarify that the carbon nanotube tubules are attached "directly" to the substrate without a linker by including the term "directly" following the term "attached" in claim 1, and the term "attached directly to a substrate" following the term "one pair of carbon nanotube tubules" in claim 24. The amendments have been made for clarification purposes only and not to limit the originally intended scope of the claimed invention in any way. No new matter is added.

Dependent claims 2-5, 7-8, 11-12 and 14-23 depend from independent claim 1 and dependent claims 25-27, 29-30, 33-39 and 41-43 depend from independent claim 24. Because Colbert et al. do not anticipate either independent claims 1 or 24, that reference does not anticipate any of dependent claims as well.

In view of the above amendments to the claims, Applicants respectfully request that the rejection under 35 U.S.C. § 102(b) be reconsidered and withdrawn.

VII. Claim Rejections Under 35 U.S.C. § 103(a)

Rejection of Claim 6 under 35 U.S.C. § 103(a) over Colbert et al. in view of Deguchi et al.

Claim 6 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Colbert et al. (WO 98/05920, published February 12, 1998) in view of Deguchi et al. (U.S. Patent No. 6,400,091, filed March 14, 2000).

The Office Action states that “Colbert et al. disclose a carbon nanotube array device comprising at least one nanotube with a proximal end and a distal end, said proximal end attached to a substrate and said tubule further comprising a metallic material (page 38, line 25-page 39, line 23 and Fig. 8) wherein the metallic material is selected from one of several metals e.g. nickel, platinum or cobalt (page 41, lines 19-21) but they do not teach the metallic material is gold” and that “however, it was well known in the art at the time the claimed invention was made that carbon nanotube preferably contained gold as taught by Deguchi et al. (Column 6, lines 39-61) wherein the addition of metals such as gold prevent nanotube from being denatured (Column 6, lines 46-49).” The Office Action concludes that “it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the nanotubes of Colbert et al. by incorporating gold as taught by Deguchi et al. for the expected benefit of preventing the nanotubes from being denatured as taught by Deguchi et al. (Column 6, lines 46-49).” Applicants respectfully traverse the rejection.

Response

Applicants bring to the Examiner’s attention the priority filing date of Applicants’ invention precedes the issue date of Deguchi et al. Applicants filing date for the present invention was January 9, 2002, which claims priority to U.S. Provisional Application No. 60/260,758, filed on January 10, 2001. Since Deguchi et al. did not issue until June 4, 2002, the combination of Deguchi et al. and Colbert et al. cannot be held to be prior art over Applicants’ claimed invention under 35 U.S.C. § 103(a). Submitted herewith is the first page of the present

application together with the filing receipt of the Applicants' provisional application, which support the filing dates of Applicants' present invention.

Furthermore, Colbert et al. neither teaches nor suggests the claimed invention having a carbon nanotube array attached directly to a substrate surface for reasons stated hereinabove in this response.

The combination of Colbert et al. and Deguchi et al., therefore, cannot be construed to teach or suggest Applicants' claimed invention, so as to render Applicants' claimed invention obvious. Applicants respectfully request that the rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Rejection of Claims 9, 10, 23, 31, 32 and 40 under 35 U.S.C. § 103(a) over Colbert et al. in view of Massey et al.

Claims 9, 10, 23, 31, 32 and 40 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Colbert et al. (WO 98/05920, published February 12, 1998) in view of Massey et al. (U.S. Patent No. 5,866,434, issued February 2, 1999).

Regarding Claims 9, 10, 31 and 32, the Office Action states that "Colbert et al. disclose a carbon nanotube array device comprising at least one nanotube with a proximal end and a distal end, said proximal end attached to a substrate and said tubule further comprising a metallic material (page 38, line 25-page 39, line 23 and Fig. 8) but they do not teach the device wherein the metallic material is particulate (e.g. bead) and at a terminal end of the nanotube" and "however, Massey et al. teach a similar device comprising at least one nanotube comprising metallic material at a terminal end wherein the metallic material is a magnetic bead (Column 54, lines 1-20)." The Office Action also states that "Massey et al. further teach the magnetic bead at a terminal end "dramatically" improves the surface area (Column 54, lines 5-8) and are "extremely useful" for separation assays (Column 52, lines 36-42)" and "therefore, it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the nanotubes of Colbert et al. by providing a magnetic bead at a terminal end as taught

by Massey et al. for the expected benefit dramatically improving surface area and easy separation as taught by Massey et al. (Column 52, lines 36-42 and Column 54, lines 1-20)."

Regarding Claims 23 and 40, the Office Action states that "Colbert et al. teach the device wherein the biological compound is DNA (page 24, lines 4-7) but they are silent regarding the DNA being single-stranded" and that "however, Massey et al. teach the similar device wherein the biological compound is single-stranded DNA (Column 53, lines 52-67) whereby the DNA probe assays are performed with dramatically improved surface area (Column 54, lines 1-20)." The Office Action concludes that "it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to apply the single-stranded DNA of Massey et al. to the DNA taught by Colbert et al. for the expected benefit of performing DNA probe assays with dramatically improved surface area as taught by Massey et al. (Column 54, lines 1-20)."

Applicants respectfully traverse the rejection.

Response

As stated hereinabove, Colbert et al. neither teach nor suggest carbon nanotube tubules attached directly to the surface of a substrate. The combination of Colbert et al. and Massey et al., therefore, cannot be construed to teach or suggest Applicants' claimed invention, so as to render Applicants' claimed invention obvious.

Furthermore, Massey et al. disclose metallic beads attached to carbon nanotube tubules that can be made magnetic, to which is attached a component linked to a label compound capable of being induced into luminesce, for example, an electrochemiluminescent (ECL) compound (column 17, lines 14 through 24). Also, Massey et al. require a nanotube having a functional group to which an assay-performance-substance is linked (column 7, lines 50 through 57), which in turn is linked to the ECL compound (column 16, lines 46 through 45), which in turn a nucleic acid is alternatively attached (column 16, line 64 through column 17, line 3). The electrochemiluminescent moiety is an essential prerequisite in Massey et al. For instance, Massey et al. states, in Example 14, "biotinylated single stranded DNA can be bound to fibril-biotin-streptavidin (FBS) supports" (column 53, lines 54 through 55). The DNA probe assay disclosed by Massey et al. (depicted in Example 6 and Figure 4) in fact, necessarily requires an

electrochemiluminescent moiety to be attached to the DNA molecule. Applicants' invention, on the other hand, does not require an electrochemiluminescent moiety for its function, but involves electrically conductive organic compounds. Since the device in Massey et al. is not enabled without the electrochemiluminescent moiety, Massey et al. in fact, teach away from Applicants' claimed invention.

Applicants respectfully request that the rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Rejection of Claim 13 under 35 U.S.C. § 103(a) over Colbert et al. in view of Chuang et al.

Claim 13 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Colbert et al. (WO 98/05920, published February 12, 1998) in view of Chuang et al. (U.S. Patent No. 6,062,931, issued May 16, 2000).

The Office Action states that "Colbert et al. disclose a carbon nanotube array device comprising at least one nanotube with a proximal end and a distal end, said proximal end attached to a substrate and said tubule further comprising a metallic material (page 38, line 25-page 39, line 23 and Fig. 8) wherein the nanotubes are bound to the substrate (page 39, lines 3-8 and Fig. 8) but they are silent regarding the composition of the substrate" and that "however, it was well known in the art at the time the claimed invention was made that silicon is the preferred substrate material for binding nanotubes as taught by Chuang et al. (Column 1, lines 61-67)." The Office Action concludes "therefore, it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to apply the silicon substrate of Chuang et al. to the substrate of Colbert et al. for the expected benefit of providing for the most effective nanotube binding as taught by Chuang et al. (Column 1, lines 61-67)." Applicants respectfully traverse the rejection.

Response

As stated hereinabove, Colbert et al. neither teach nor suggest carbon nanotube tubules attached directly to the surface of a substrate. Chuang et al. do not remedy this deficiency

because Chuang et al. do not teach or suggest a carbon nanotube array device in which the distal end of a carbon nanotube tubule is attached directly to a substrate. Chuang et al. disclose a cold cathode emitter structure having a catalytic material that is converted to a discontinuous layer, in between the carbon nanotubes and the substrate (Figure 6), which can be silicon.

Even if silicon is taught as a substrate material, the combination of Colbert et al. and Chuang et al. does not teach or suggest every element of Applicants' claimed invention. Because neither Colbert et al. nor Chuang et al. teach or suggest all of the claim limitations of Applicants' claimed invention, the combination of Colbert et al. and Chuang et al. fails to render Applicants' claimed invention obvious. Applicants respectfully request that the rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

VIII. Notice to Comply With Nucleic Acid Sequence Rules

The Office Action States that "(Fig. 16) contains sequence disclosures that are encompassed by the definitions for nucleotide and/or amino acid sequences set forth in 37 C.F.R. § 1.821(a)(1) and (a)(2)" and that the "application fails to comply with the requirements of 37 C.F.R. §§ 1.821-1.825".

Response

Applicants submit herewith a copy of the "Sequence Listing" (sheet 1) in paper form as required by 37 C.F.R. §1.821(c) and a copy of the Sequence Listing in computer readable form as required by 37 C.F.R. §1.821(e). As required by 37 C.F.R. §1.821(f), Applicants' Attorney hereby states that the content of the "Sequence Listing" in paper form and the computer readable form of the "Sequence Listing" are the same and, as required by 37 C.F.R. §1.821(g), also states that the submission includes no new matter.

Applicants submit that all claims are allowable as written and respectfully request early favorable action by the Examiner. If the Examiner believes that a telephone conversation with Applicant's attorney/agent would expedite prosecution of this application, the Examiner is cordially invited to call the undersigned attorney/agent of record.

Respectfully submitted,

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